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ABSTRACT

This document is a collection of three papers: (1) "Some Variables Why So Few Black High School Graduates Attend Post-High School Area Vocational Schools," by Max Farning, (2) "The Role of Simulation in Teaching Complex Problem Solving Skills," by Curtis R. Finch and Patrick A. O'Reilly, and (3) "Investigation of the Effectiveness of a Design to Initiate Curriculum Change," by Mary Bach Kievit. Farning concludes that two variables have influenced the low enrollment rate of blacks: (1) negative attitudes toward blue collar employment, and (2) lack of knowledge about post-secondary area vocational schools. Finch and O'Reilly analyze the effectiveness of dynamic simulation as a means of teaching troubleshooting and discuss several implications for state-level vocational education planning, local utilization of simulators, and minimization of individual differences between students. Kievit considers a design for curriculum change based on teacher workshops. (BH)

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SOME VARIABLES WHY SO FEW BLACK HIGH SCHOOL GRADUATES ATTEND POST-HIGH SCHOOL AREA VOCATIONAL SCHOOLS[1]

By Max Farning[2]

THE PROBLEM AND THE BACKGROUND

The Problem

It is apparent that the black race is not proportionately represented in the post-high school area vocational schools in Minnesota. Many young blacks who need to learn a saleable skill if they are to become successful wage earners in our technological society are not learning these skills.

The purpose of this study was to determine why so few black male high school graduates attend post-high school area vocational schools.

It is hoped that the information provided by this study will ultimately result in black students making greater use of available educational opportunities.

Review of the Literature

Studies (Krauss, 1964; Wilson, 1959; Bendix, Lipset and Malm, 1954; Harris, 1970) support the hypothesis that the parents' level of education is positively related to the sons' probable level of education. Others (Jenson and Kirchner, 1955; Carp, 1949; Stephenson, 1957; Krauss, 1964) found that the occupational level of the father is positively

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[1]This article is a part of the author's Ph.D. thesis submitted to the Faculty of the Graduate School, University of Minnesota. Dr. Jerome Moss, Jr. was the major advisor.

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related to the occupational choice of the son. Another study (Uzzell, 1961) found a definite relationship between the occupational choices of black male high school seniors and their knowledge of adults who were working in that occupation. Vontress (1968) discussed the apathy of socio-economically disadvantaged black parents and children toward education.

Wylie (1963) found that when she held age and intelligence constant, students from low socio-economic homes and black students have a more modest self-estimate of their ability to do school work than do other students. Another study (Leshan, 1952) indicated that students from lower-class homes do not look to the future as do other students. Other studies (Schwarzweller, 1960; Hindelang, 1970; Rosen, 1959) supported the hypothesis that the culture in which the child is reared affects his educational and occupational aspirations and expectations.

Keller and Zavalloni (1964) presented a concept that they called relative distance. This concept says that some socio-economic groups are farther from some goals than are other socio-economic groups. For example, the relative distance (including values, attitudes, opinions, self-concept, etc.) from high school to college is greater for the black ghetto student than for the white non-ghetto student.

Siegel (1965-1966) found that when the years of education and region of the U.S. are held constant, blacks do earn considerably less than whites, and as the years of education increase, the difference in annual dollars earned also increases. Studies (Siegel, 1965-1966; Littig, 1968; Landis and Scorpitti, 1965; Brazziel, 1961; Henderson, 1966, 1967) showed that blacks do perceive themselves as having fewer employment opportunities than whites have and that consequently blacks

usually expect to enter a lower level occupation than whites. Littig's (1968) study indicated that working-class black college students having strong achievement motivation are more likely than other blacks to attempt to get into occupations which have been traditionally closed to blacks. After conducting two MDTA programs in a black ghetto, Ekberg and Vry (1968) concluded that the black ghetto student expects to fail, and probably wants to fail, in the white man's world.

Personal Interviews

The investigator conducted personal interviews in the Minneapolis-St. Paul area over a period of approximately four months--mid-July to mid-November, 1970. The interviews were undertaken so that hypotheses could be developed about why so few black male high school graduates attend post-high school vocational schools. Although it is difficult to determine the respective proportions that the literature review and personal interviews contributed to the hypotheses development, the investigator did rely very heavily on the personal interviews. As an estimate, the personal interviews probably contributed 75%, with the review of literature contributing 25%.

DESIGNING THE STUDY

Hypotheses

As a result of the literature review and interview procedure, the investigator formulated 22 major hypotheses and 22 minor hypotheses.

The major hypotheses are as follows:

(1-11) There is a difference between the black and white races when male high school seniors are grouped according to

race and what they expect to be doing next year (attending college, attending a post-high area vocational school, or having a full-time job) in (1) their perception of labor unions, (2) their perception of area vocational schools, (3) their perception of blue collar work, (4) the extent to which they hold "white middle-class" values, (5) their level of self-confidence as it relates to their ability to succeed in school and in the world-of-work, (6) their perception of how their parents perceive education, (7) their perception of how their friends perceive education, (8) the extent to which they concur with the concept "education is good," (9) the extent to which they concur with the concept "teachers are good," (10) the extent to which they concur with the statement "school counselors are good," and (11) their level of knowledge about post-high area vocational schools.

The minor hypotheses are as follows:

(1a-3a) Within each race, black and white, there is a difference between high school seniors who expect to attend a post-high area vocational school next year and those who do not expect to attend a post-high area vocational school next year in (1a) their perception of labor unions, (2a) their perception of post-high area vocational schools, and (3a) their perception of blue collar work.

(4a-10a) Within each race, black and white, there is a difference between high school senior males who expect to attend school next year and those who do not expect to attend

school next year in (4a) the extent to which they hold "white middle-class" values, (5a) their level of self-confidence as it relates to their ability to succeed in school and the world-of-work, (6a) their perception of how their parents perceive education, (7a) their perception of how their friends perceive education, (8a) the extent to which they concur with the concept "education is good," (9a) the extent to which they concur with the concept "teachers are good," (10a) the extent to which they concur with the concept "school counselors are good."

(11a) Within each race, black and white, there is a difference between high school senior males who <u>expect</u> to attend a post-high area vocational school next year and those who <u>expect</u> to have a full-time job in their level of knowledge about area vocational schools.

(12-22 and 12a-22a) [Hypotheses 1 through 11 and 1a through 11a were developed to test differences when students are grouped according to what they <u>expect</u> to be doing next year. The same set of hypotheses will be tested when students are grouped according to what they <u>would like</u> to be doing next year.]

The Instrument

To test the hypotheses, it was necessary to develop an instrument which would permit the data to be gathered. First it was necessary to determine what each student expected to be doing the next year (attending college, attending an area vocational school, having a full-time job or

other) and also what each student would like to have been doing next year. This part of the instrument is presented in Table 1.

TABLE 1

STATEMENTS DESIGNED TO GATHER DATA ON WHAT THE STUDENT WOULD LIKE TO BE DOING NEXT YEAR AND ON WHAT THE STUDENT EXPECTS TO BE DOING NEXT YEAR.

Name _____

If you could do anything you wanted to do, what would you <u>really</u> <u>like</u> to be doing a year from now? (please, be honest)

_____ Attending a university or 4-year college

_____ Attending a junior college

_____ Attending an area vocational school

_____ Having a full-time job

_____ Being in the U.S. Armed Forces

_____ Other, please list _____

What do you <u>really</u> <u>expect</u> that you will be doing a year from now?

_____ Attending a university or 4-year college

_____ Attending a junior college

_____ Attending an area vocational school

_____ Having a full-time job

_____ Being in the U.S. Armed Forces

_____ Other, please list _____

Eleven other different kinds of information were also needed to test the hypotheses. After reviewing the types of instruments which could be used to obtain the eleven different kinds of information, the investigator decided to collect ten kinds of information using a Likert-type instrument having four alternative responses (strongly agree, agree, disagree, strongly disagree).

In the ten Likert scales approximately half of the item statements are positive (i.e., I like school) and half of the item statements are negative (i.e., Education is of little value). For each positive item statement, 4 points were given for each strongly agree (SA) response, 3 points for agree (A), 2 points for disagree (D), and 1 point for strongly disagree (SD). For negative item statements the scoring was reversed. For each of the ten scales, each subject's score was the total points earned on the items in that scale.

It was decided to test the hypotheses concerning the "student's knowledge of area vocational schools" using a dichotomized response choice--true or false. The scoring for these items was as follows: no point for each incorrect response and one point for each correct response.

In summary, each subject had eleven total scores--one for each of the eleven scales. These scale scores were then used to test the hypotheses.

Building a Pool of Items

A pool of sixteen to thirty-six items was developed for each of the eleven scales. The investigator depended heavily upon the personal interviews when developing the items; the literature review also contributed substantially to the "key words" on which items were built.

Content Validity

Each of the 259 items developed was typed on a 3" by 5" card. Each of the eleven hypothesis areas, i.e. perception of labor unions, was typed on a 5" by 8" card. Ten professional people actively involved in vocational education were asked by the investigator to participate in the test for content validity. After the project director put the 259 item cards in random order, each participating educator was asked to sort the 259 item cards according to the eleven hypotheses cards and was told that if he felt that any of the items did not fit any of the eleven hypotheses cards that these items should be put into a separate pile. The criterion for acceptance of each item was that a minimum of nine of the ten participating educators sort the items into the correct category (scale). Twelve items did not meet the criterion and were removed.

Pilot Testing the Instrument

The 247 remaining items, with the exception of sixteen items which tested "knowledge of area vocational schools," were placed in random order. Because chance might group some items testing the same hypothesis close together, the investigator checked to see if such groupings occurred. Whenever there were less than four or five items between two items which seemed to be asking something quite similar, one of the items was moved to another position. All items measuring students' knowledge of area vocational schools were put at the end of the instrument.

A total of thirty-one students completed the instrument for the pilot test. After the pilot test was concluded it was decided to eliminate the hypotheses dealing with the student's level of self-confidence

as it relates to his perception of his ability to succeed in school and in the world-of-work (hypothesis 5, 5a, 16 and 16a). When the investigator asked the students in the pilot test to comment on the instrument, several stated that they felt some items were rather personal (these items were the self-confidence items). School administrators also felt that some students might be sensitive to the same items. While the investigator did feel that the hypotheses concerning self-confidence were important, he did not want to take a chance that these items would influence students' responses to the other items. Consequently, the items pertaining to these hypotheses were eliminated prior to the administration of the final instrument.

Item Analysis and Reliability

The University of Minnesota Statistical Program 500 (UMST 500), with the Control Data Corporation 6600 computer, was used for the item analyses (Anderson, 1969). This program provides correlation coefficients between each item and every other item in the same scale, in addition to the correlation coefficient between each item and the total score for its scale. Those items having the lowest correlation with their total scale scores were eliminated first. If two items tended to be similar, the one having the lower correlation coefficient with the total scale score was eliminated.

Ferguson (1966, p. 377) places the methods of determining reliability into four categories: (1) test-retest, (2) parallel-forms, (3) split-half, (4) internal consistency. Hoyt's method (Hoyt, 1941) of measuring internal consistency was selected.

Of the original 259 item pool, twelve were removed as a result of the test for face validity, and sixty-one were removed as the result of

the item analysis. Also, the entire self-confidence scale was removed. Of the 259 items originally developed, 155 were left. These 155 items, less the sixteen items on the "knowledge of area vocational schools" scale, were then placed in random order to build the instrument.

Internal consistency when based on the 77 students in the final sample ranged from a low of .60 for the scale measuring the students' knowledge about area vocational schools to a high of .90 for the scale measuring the students' level of agreement with the concept "school counselors are good." An example of the scales, "the scale measuring the students' perception of area vocational schools," is in the appendix.

DATA COLLECTION

The data was gathered in two schools in St. Paul, Minnesota, in late spring, 1971. It was decided to collect the data in two phases. In Phase I, a single sheet questionnaire was administered to all senior boys in the two schools requesting (a) the student's name, (b) what he would <u>really like</u> to be doing next year, and (c) what he <u>really expects</u> to be doing next year (see Table 1).

Using the students' response to the statement: "What do you <u>really expect</u> that you will be doing a year from now?" students were then grouped according to whether they expected to be (a) attending a university, 4-year college, or junior college, (b) attending a post-high area vocational school or similar institution, or (c) having a full-time job. Those who indicated that they expected to enter the U.S. Armed Forces or gave a response such as "travel for a year" were put in a fourth category and were not included in the sample for Phase II. It was felt that these students were postponing for one or several years the decision of whether to attend school or to get a full-time job.

Those who responded in the "other" category with a statement which indicated one of the above three categories, i.e.,"have my own repair shop," were placed in the appropriate category.

Those remaining in the fourth group--U.S. Armed Forces and "other"--were set aside, which left the following six groups:

Black	White
College	College
Vocational School	Vocational School
Job	Job

Seven students were randomly selected from each of six groups. Because of normal, expected absenteeism, one substitute was also randomly selected from each group.

The same sampling procedure was then repeated for the question, "If you could do anything you wanted to do, what would you <u>really</u> <u>like</u> to be doing a year from now?" Thus, two samples were drawn: one from a population based upon what the student expected to be doing, and the other from a population based upon what the student would like to be doing (each sample consisted of forty-two students). Because the first random sampling procedure (when the parameters were race and what the students <u>expected</u> to be doing next year) was independent of the second random sampling procedure (when the parameters were race and what the students would like to be doing next year), seven students were selected for both random samples.

For Phase I, the population was all the senior male students in the two schools. For Phase II, the population was all the senior male students in the two schools with the exception of those students who expected to (or would have liked to) enter the U.S. Armed Forces or

travel for the year following their high school graduation. Prior to the administration of the final questionnaire, Phase II, a school counselor notified the selected students to report to a designated room at a specific time. The investigator administered Phase II questionnaire. After the students arrived in the designated room, the investigator explained that he was interested in knowing how they, as students, felt about a variety of things and that they should be completely honest as all of their responses would be confidential.

Students were told that it was very important for them to respond to every question and that if they had difficulty answering some items that they should make the best possible guess. Most students completed the questionnaire within forty-five minutes; a few spent slightly over one hour. As the students were nearing completion of the instrument, the investigator announced that each one should make sure that he had responded to all the statements before he handed in the questionnaire. Also, as the students handed in the questionnaire, the investigator quickly checked to see if they had responded to all items.

Analysis of variance, using orthogonal contrasts, was the statistical technique used. Table 2 presents a summary of the probability values for each of the hypotheses.

TABLE 2

SUMMARY TABLE OF THE PROBABILITY VALUES FOR THE HYPOTHESES WHEN USING ANALYSIS OF VARIANCE WITH ORTHOGONAL CONTRASTS

	When students are randomly selected according to what they expect to be doing next year: attending college, attending an area vocational school, or having a full-time job.			When students are randomly selected according to what they would like to be doing next year: attending college, attending an area vocational school, or having a full-time job.		
	Black vs. white	Vocational school vs. college and job (black)	Vocational school vs. college and job (white)	Black vs. white	Vocational school vs. college and job (black)	Vocational school vs. college and job (white)
Perception of labor unions	.772	.143	.076	.833	.557	.293
Perception of area vocational schools	.764	.002**	.050*	.539	.402	.011*
Perception of blue collar work	.012*	.012*	.009**	.153	.280	.280

(table continued on next page)

(Table 2 continued)

	When students are randomly selected according to what they expect to be doing next year.			When students are randomly selected according to what they would like to be doing next year.		
	Black vs. white	Vocational school and college vs. job (black)	Vocational school and college vs. job (white)	Black vs. white	Vocational school and college vs. job (black)	Vocational school and college vs. job (white)
Middle-class values	.142	.055	.041*	.042*	.750	.791
Reinforcement from parents	.285	.002**	.008**	.325	.496	.706
Reinforcement from friends	.123	.306	.0009**	.689	1.000	.045*
Concept "education is good"	.163	.241	.002**	.115	.171	.066
Concept "teachers are good"	.961	.197	.137	.165	1.000	.186
Concept "school counselors are good"	.724	.638	.303	.437	.559	.604

(Table continued on next page)

(Table 2 continued)

	When students are randomly selected according to what they expect to be doing next year.			When students are randomly selected according to what they would like to be doing next year.		
	Black vs. white	Vocational school vs. job (black)	Vocational school vs. job (white)	Black vs. white	Vocational school vs. job (black)	Vocational school vs. job (white)
Knowledge of area vocational schools	.042*	.019*	.346	.013*	1.000	.315

* Indicates statistically significant at .05 level.

** Indicates statistically significant at .01 level.

[Text continued on next page.]

When limiting the discussion to the statistically significant (.05 level) results when the students were randomly selected within categories of race and what they expected to be doing the next year, only two differences between race were found: the white groups scored differently (higher) than the black groups on the scales measuring (a) perception of blue collar work and (b) knowledge about area vocational schools. Seven of the ten sets of null hypotheses testing for differences within race revealed that either one or both of the two contrasts were significant (.05): (a) within each of the two races students who expected to be attending an area vocational school scored differently (higher) than students who did not expect to be attending an area vocational school on the scale measuring perception of area vocational schools; (b) within each of two races, students who expected to be attending an area vocational school scored differently (higher) than students who did not expect to be attending an area vocational school on the scale measuring their perception of blue collar work; (c) within the white race, students who expected to be attending school (either college or vocational school) scored differently (higher) than students who expected to have a full-time job on the scale measuring white middle-class values (the direction of difference was the same for blacks); (d) within each of the races, students who expected to be attending school (either college or vocational school) scored differently (higher) than students who expected to have a full-time job on the scale measuring perception of reinforcement from their parents on school and educational activities; (e) within the white race, students who expected to attend school (college or vocational school) scored differently (higher) than students who expected to have a full-time job on the scale measuring perception of reinforcement from

friends on school and educational activities (the direction of difference was the same for blacks); (f) within the white race, students who expected to attend school (college or vocational school) scored differently (higher) than students who expected to have a full-time job on the scale measuring the concept "education is good" (the direction of difference was the same for blacks); (g) within the black race, students who expected to be attending an area vocational school scored differently (higher) than students who expected to have a full-time job on the scale measuring their knowledge about area vocational schools (the direction of difference was the same for whites).

When the students were randomly selected within the categories of race and what they would like to do next year, only two differences between race were found to be statistically significant (.05): the white groups scored differently (higher) than the black groups on the scales measuring (a) white middle class values and (b) knowledge about area vocational schools. Two of the ten sets of null hypotheses making contrasts within each race were found to yield statistically significant (.05) differences: (a) within the white race, students who would like to attend an area vocational school scored differently (higher) than students who would like to attend college or have a full-time job on the scale measuring perception of area vocational schools (the direction of difference was the same for blacks); (b) within the white race, students who would like to be attending school the next year scored differently (higher) than students who would like to have a full-time job on the scale measuring perception of reinforcement from friends.

The study revealed a strong probability that two reasons why so few black high school graduates attend post high school area vocational

schools are: (a) black male high school seniors do not perceive "blue collar" employment to be as "worthy or dignified" as white male high school seniors do, and (b) black male high school seniors have less knowledge about post high school area vocational schools than white male high school seniors have.

RECOMMENDATIONS

Recommendations for practice are that a program be initiated whereby (a) black male students would come to perceive "blue collar" work as having more "worth and dignity" than they now have, and (b) black male students would possess more knowledge about area vocational schools. (This program could be considered successful only if it results in an improvement of the socio-economic position of the black race; it must not be used as a way of "keeping or putting" blacks in blue collar positions.) It is also suggested that similar research be conducted with other socio-economic groups including American Indians, Mexican-Americans, and economically depressed whites. It is also suggested that further research be conducted on students' attitude toward blue collar work as this might be a very significant factor why so few black students, as well as other minority group students, enroll in post high school area vocational schools.

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APPENDIX

Scale Used to Measure Students' Perception of Area Vocational Schools

(hypotheses 2, 2a, 13, and 13a)

Today, a young man can get a good education by attending an area vocational school.

Only students who can't get into a good college or university go to an area vocational school.

We need area vocational schools.

If you want people to respect you, you must go to a university or college rather than to an area vocational school.

I would rather graduate from a college than from an area vocational school.

Students who attend area vocational schools are respected by other people in the community.

A person who has graduated from a college has more dignity than one who has graduated from an area vocational school.

Area vocational schools are first-class schools.

There are many intelligent students going to area vocational schools.

Going to college would give a student more dignity than going to an area vocational school.

I would like to go to an area vocational school.

Area vocational schools are for people who cannot "think."

If you really want to be "somebody," you have to go to a university or college.

Area vocational schools are good schools.

Area vocational schools are as important as colleges and universities.

		Strongly Agree	Agree	Disagree	Strongly Disagree
71	School counselors are not worth what they are paid.	S A	A	D	S D
72	There are many intelligent students going to area vocational schools.	S A	A	D	S D
73	I enjoy school.	S A	A	D	S D
74	Most of my friends are concerned about their school grades.	S A	A	D	S D
75	School counselors don't know what they are doing.	S A	A	D	S D
76	My parents think that school is important.	S A	A	D	S D
77	I don't trust school counselors.	S A	A	D	S D
78	Most teachers are concerned about students.	S A	A	D	S D
79	Most of what we learn in school is important.	S A	A	D	S D
80	Most students in my senior class can do their school assignments better than I can.	S A	A	D	S D
81	Labor unions are honest organizations.	S A	A	D	S D
82	My parents really don't care if I graduate from high school.	S A	A	D	S D
83	If you really want to be "somebody," you have to go to a university or college.	S A	A	D	S D
84	I want a "blue collar" job.	S A	A	D	S D
85	Most school counselors are friendly.	S A	A	D	S D
86	I hate teachers.	S A	A	D	S D
87	Labor union officers are honest.	S A	A	D	S D

THE ROLE OF SIMULATION IN TEACHING COMPLEX PROBLEM SOLVING SKILLS[1]

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THE ROLE OF SIMULATION IN TEACHING COMPLEX PROBLEM SOLVING SKILLS

One of the most difficult tasks which faces an instructor is that of teaching a student how to solve problems. A primary reason for instructional difficulty stems from the fact that problem solving requires an individual to perform at a rather high and complex level. As indicated by Gagné (1965), when a person solves a problem he combines "principles he has already learned into a great variety of novel higher order principles."

In order to teach problem solving in a meaningful manner, provision is often made within a course for the inclusion of practical problem solving experiences. For example, mathematics instructors might provide students with problems to solve which make direct application of the principles taught in class. In science courses, students may use laboratory facilities to solve problems related to classroom instruction. In fact, problem solving experiences can be meaningful to students irregardless of the course one happens to be enrolled in. Bruner (1970) states that:

> Good problems, it turns out on closer inspection, are the chief vehicle for good curricula whether one is in an ordinary classroom or alone in a cubicle with a teaching machine.

It is within the area of vocational-technical education that applied problem solving instruction is of utmost importance. A number of occupations require that workers be proficient diagnostic problem solvers or troubleshooters (U. S. Department of Labor, 1965). Students who aspire to these occupations should, therefore, receive experiences which assist them in the development of troubleshooting proficiency.

A number of investigations has indicated that simulators can provide troubleshooting instruction which is at least equal to that afforded by actual

equipment (Standlee, et al. 1956; Trafton, 1962). There are, however, several shortcomings relative to these studies. First, many have examined special purpose simulators which were oriented toward the solving of specific problems in specific pieces of equipment. The simulators, therefore, were not of a type which allow use in several vocational-technical instructional areas. Second, the subjects utilized in these studies were, for the most part, military rather than civilian students. Consequently, research results may have limited generalizability to vocational-technical high school enrollees, particularly to those students who are culturally and academically disadvantaged.

A final point should be made regarding research in public vocational education which focuses on simulation. Studies dealing with this topic have been, for the most part, concerned with cognitive or verbal skill development (Impellitteri and Finch, 1971). Ultimately, however, vocational objectives are directed toward the application of these skills (and others) in a realistic setting. Not only must the student learn a principle but he should be able to transfer this principle to situations similar to those he will encounter in the work environment. The worth of simulation then lies in the extent to which it can develop skills which have acceptable transfer to realistic (work environment type) tasks. Unfortunately, few of the studies conducted in public vocational education have even approached this standard.

OBJECTIVES

This paper reports the results of a study which examined the feasibility of teaching troubleshooting in vocational-technical education using a dynamic simulation approach. Emphasis was placed on teaching disadvantaged youngsters at the secondary level. More specifically the investigation sought answers to

the following questions: (1) What is the general effectiveness of dynamic simulation in teaching troubleshooting? (2) What relationships exist between student characteristics and the learning of troubleshooting via dynamic simulation? (3) What attitudes do students have toward dynamically simulated troubleshooting instruction? (4) How do teachers perceive the effectiveness of troubleshooting instruction via dynamic simulation?

SAMPLE

It was felt important to identify a sample which would be representative of students receiving troubleshooting instruction in vocational-technical education. Based upon discussions with several vocational school directors at the project's inception, it was decided to examine simulator effectiveness using students from the auto mechanics area. An in-depth study of automotive troubleshooting instruction via simulation appeared to be feasible since instruction in this area is provided in many vocational-technical schools. Additionally, automotive service involves troubleshooting of electrical and electromechanical systems. In effect, the troubleshooting performed by automotive service personnel is not unlike that performed by persons in other maintenance areas. Systems in the many maintenance areas have generally similar characteristics (electrical and electromechanical). They also require a troubleshooter to apply system knowledge and strategies in order to identify a malfunction.

The sample consisted of all sophomore, junior, and senior automotive students enrolled at three Pennsylvania area vocational technical schools as well as all students in the service station mechanics program at a fourth school. Half of the remaining automotive students at the fourth school were also included in the sample.

The net available sample was composed of those students who, in addition to providing personal data, completed the Automobile Engine Knowledge Examination and the Troubleshooting Performance Test. Of this sample (n = 205), 105 made up the treatment group while the non-treatment group numbered one hundred.

THE SIMULATOR

In order to simulate troubleshooting experiences, the System Malfunction Analysis Reinforcement Trainer (SMART) was utilized. This particular unit, which has been developed by Educational Computer Corporation, features interchangeable panels and logic that permits the simulation of electrical and/or mechanical systems in automobiles, heating and air conditioning systems, and various appliances.

Numerous problems may be easily inserted in each panel and the student "troubleshoots" each system by pressing buttons at various locations on the panel. The simulator provides immediate feedback for each check which the student performs. This feedback can be in the form of pictures or words (on slides) and color indications on the various buttons. Provision for recording student elapsed time to find each trouble as well as checks and repairs/replacements made is also incorporated into the simulator.

INSTRUCTIONAL CONTENT

Although the simulator provided students with feedback as they attempted to "find" troubles, it was also felt necessary to make other materials available that would assist them in the development of appropriate troubleshooting strategies. Consequently, each student was provided with a Troubleshooting Booklet which led him through various representative troubles and provided him with a general procedure to follow as he attempted to find each trouble.

The material, which was developed by Educational Computer Corporation and modified for use in this study, was programed in a linear format. It was written so that instruction could be provided on an individual basis and would be self-paced. By using the booklet each student was able to receive troubleshooting instruction "on his own," however, instructors were available to provide assistance in order that each person would be kept "on the right track."

A troubleshooting Answer Sheet was also developed for use in conjunction with the Troubleshooting Booklet and simulator. Its purpose was to gather data relative to each student's progress on the simulator and provide him with simulated applications of his instruction. At three points in the booklet the student was asked to find a different trouble which was placed in the simulator system. Each trouble was representative of those which he practiced with but was different from any of those in the instructional sequence. For each trouble he was asked to record time to solution, as well as the number of tests and repairs/replacements made.

MEASURING INSTRUMENTS

A number of measuring instruments were used to gather relevant data from students involved in the study. Several of these were standardized measures while others were developed specifically for the study. Student ability and background data were gathered by means of the California Test of Mental Maturity, the Short Test of Occupational Knowledge, an Automotive Engine Knowledge examination, a school motivation scale (Russell, 1969), and a student information sheet. Students who completed the simulator instruction provided their reactions to and attitudes toward the learning experience by

completing a student reaction form and an instruction attitude inventory (Finch, 1969a). Instructors expressed their feelings about simulator utility by completing an evaluation questionnaire. Finally, all students involved in the study completed a troubleshooting performance test. This test, which was the dependent variable, evaluated a person's ability to troubleshoot (find troubles in) an automobile engine. The troubleshooting performance test was designed to meet several unconventional requirements. First, it should evaluate a student's ability to troubleshoot (find troubles in) an automobile engine. Second, it should be appropriate for use with the automotive students of eight instructors in four vocational-technical schools.

This measure required each examinee to locate two troubles which were representative of those an auto mechanic or an advanced automotive student might be required to find. One of the troubles was located in the engine fuel system while the other was in the electrical system. Materials used during the examination administration consisted of examiner's instructions, examinee's instructions, and a record of troubleshooting behavior.

Performance sub-scores were established based upon data from a previous investigation (Finch, 1969b) and a review of research in the area of problem solving performance measurement. Since a number of possible performance sub-scores could be derived, it was felt best to examine troubleshooting performance as defined by each of several separate sub-scores. These sub-scores or criteria consisted of proficiency, efficiency, redundancy, search time, action checks made, and information checks made. All criteria were developed from data recorded on the behavior record.[1]

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[1] The procedures used to obtain these sub-scores are detailed in a separate paper (Finch and O'Reilly, 1972a).

GENERAL DESIGN

Since this study was directed toward a multi-school, multi-teacher, multi-grade sample, it was decided to employ the statistical technique of multiple linear regression. By utilizing this technique, effects of certain independent variables may be partialed out so that the unique contribution which a particular independent variable makes to a dependent variable may be ascertained. Variables included in the analysis may be continuous or categorical, thus taking into account characteristics such as group membership and school membership. Further information on the specific program used in this study is contained in Hallberg (1969) while general descriptions of the multiple linear regression technique are provided by Bottenberg and Ward (1963) and Smith (1969).

The general model employed was

$$Y = a_o + a_1x_1 + a_2x_2 + \ldots\ldots a_nx_n + e$$

where

Y = dependent variable

$X_1, X_2, \ldots\ldots X_n$ = independent variables

$a_o, a_1, a_2 \ldots\ldots a_n$ = partial regression coefficients

e = error term

The specific equations used in this study were

$$Y_i = a_o + a_1x_1 + a_2x_2 + a_3x_3 + a_4x_4 + \ldots\ldots a_{18}x_{18} + e$$

$i = 1, 6$

where

y_1 = troubleshooting proficiency

y_2 = troubleshooting efficiency

y_3 = troubleshooting redundancy

y_4 = troubleshooting search time

y_5 = troubleshooting action checks

y_6 = troubleshooting information checks

and

x_1 = treatment

x_2 = school

x_3 = grade level

x_4 = verbal ability

x_5 = non-verbal ability

x_6 = motivation toward learning

x_7 = equipment knowledge

x_8 = occupational knowledge

x_9 = age in months

x_{10} = troubleshooting experience in school

x_{11} = troubleshooting experience outside of school

x_{12} = jobs held related to instructional area

x_{13} = hobbies related to instructional area

x_{14} = living area (employment situation)

x_{15} = father's occupation

Several other independent variables were available only for the group that received simulator instruction. These included

x_{16} = attitude toward instruction

x_{17} = time lapse between instruction and performance test

x_{18} = time to complete instruction

PROCEDURE

Early in the school year, information was gathered about the students constituting the selected sample. Each student's personal background, ability,

and motivation were assessed. Concurrent with the gathering of this information, automotive instructors received an orientation to the simulator and became thoroughly familiarized with its capabilities. This orientation was conducted by the Educational Computer Corporation staff. Additionally, simulators were installed in each of the four cooperating schools and were checked out by ECC personnel to assure that they operated properly.

After these activities had been accomplished, instructional materials were delivered to the eight cooperating teachers. These materials included the Automobile Engine Troubleshooting Booklet and answer sheet. Instructors were given sufficient time to review the booklet and use it in conjunction with the simulator. In this manner each instructor would be familiar with the instructional content and would be able to assist students with any problems encountered on the booklet or the simulator.

After all instructors had become familiar with the troubleshooting booklet and the simulator, additional troubleshooting booklets as well as copies of the Instruction Attitude Inventory, Student Reaction Form, and Troubleshooting Answer Sheet were provided to them. Concurrent with this, students were randomly selected by school, class, and year in school to either the treatment or non-treatment group. Additionally, treatment group assignment to instruction was randomly made. Instructors were then asked to present all of their automotive students, both treatment and non-treatment, with an introduction to the simulator. They gave a one class period discussion which covered the general operation of the simulator, drawing from the information in the simulator Operator's Manual. This consisted of a general overview and was not intended to include specific troubleshooting instruction. The instructors showed how the simulator operated, where the basic switches were, and what they did. At the same time, instructors told students that they might get a chance to use the unit sometime during the school year.

Students in the treatment group then began receiving simulator instruction one-by-one according to the pre-arranged schedule. Each instructor in each school gave the designated student a Troubleshooting Booklet and simulator to use. The student was asked to contact the instructor if he had any problems using the booklet or the simulator. After each student had completed his instruction on a first simulator panel, he contacted the instructor. The second panel, slides and logic were then placed on the simulator. After the student had completed all instruction, his booklet and answer sheet were collected and he completed the Instruction Attitude Inventory and Student Reaction Form. At this time, another student from the treatment group was placed on the simulator.

Approximately three or four weeks after the first student began instruction on the simulator, the research team traveled to each school to test students in terms of troubleshooting performance on actual equipment. Students tested included those who had completed instruction on the simulator as well as those randomly assigned to the control group who were randomly listed "opposite" completed treatment students. The purpose of this evaluation was to measure transfer from simulator to actual equipment. In order to accomplish this task, an engine mounted on a trailer was utilized. This unit was constructed by students at a vocational-technical school under the direction of several instructors. Concurrent with performance evaluation, students completed the Automobile Engine Knowledge Examination. This examination was designed to obtain an up-to-date indication of each student's knowledge with regard to the specific instructional area. At regular intervals, the test engine was towed to each of the four schools and student troubleshooting ability was assessed. During the later part of the school year, instructor reaction information was gathered and students' attitudes toward classroom and shop instruction were assessed.

FINDINGS AND CONCLUSIONS[1]

The general effectiveness of dynamic simulation as a means of teaching troubleshooting was examined using a treatment group and a non-treatment group. Multiple regression analysis revealed that, when other variables were held constant, the treatment group performed significantly better than the non-treatment group with regard to four of the six criterion measures. The treatment group made more action checks and more information checks. Additionally, this group was less redundant and more efficient than the non-treatment group. It should be noted that the four criteria which differentiated between treatment and non-treatment were task procedure measures rather than task end product measures. That is, they could be associated with the troubleshooting search process rather than with the result of this process. It is, therefore, contended that the simulator is most useful in terms of teaching meaningful troubleshooting strategies. In the present study, this instruction was provided in conjunction with appropriate software (programed materials). The extent to which troubleshooting strategy development can take place without supporting materials was beyond the scope of the investigation, however, it may well be that teacher-student interaction on an individual basis could be equally as effective as programed material use. Future research efforts might be directed in this area.

In order to examine the relationships between student characteristics and the learning of troubleshooting via dynamic simulation, regression analysis was conducted for those youngsters who had received simulator instruction. Findings indicated that significant relationships existed between certain independent

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[1] Detailed findings and corresponding tables may be found in Finch, Curtis R. and O'Reilly, Patrick A. The Role of Dynamic Simulation in Teaching Complex Problem Solving Skills. Englewood Cliffs, New Jersey: Educational Technology Publications, Research Series, Copyright 1972b.

variables and three of the six performance measures. These criteria included proficiency, information checks, and efficiency. Occupation knowledge and engine knowledge were unique predictors of troubleshooting proficiency, whereas, holding a job or jobs in the automotive area and engine knowledge were predictive of troubleshooting information gathering performance. A number of variables were unique predictors of troubleshooting efficiency. These included holding a job or jobs in automotive area, attitude toward instruction received, motivation toward schoolwork, occupation knowledge, and non-language ability. It is interesting to note that no one variable was consistently predictive of performance across the three criterion measures. Engine knowledge and occupation knowledge variables were predictors for two of the three performance criteria with both being significantly related to proficiency. In addition, the traditionally strong predictor of performance (verbal ability) was not significantly related to any of the troubleshooting performance criteria. It appears that, when students are being selected to be involved with this type of simulator-based instruction, consideration should be given to prior job experience, motivation toward schoolwork occupation knowledge and non-language ability if the instructional outcome is specified as increased troubleshooting efficiency. If proficiency performance is to be maximized, students should be selected on the basis of occupation knowledge and specific equipment (in this case engine) knowledge. Last, with regard to selecting those students who will perform best at information gathering, student job experience and specific equipment knowledge should be examined.

Several points regarding instructor reactions to the simulator should be mentioned. First, the teacher group appeared to feel that the simulator was an effective instructional device for teaching troubleshooting. They additionally felt that the simulator motivated students in a positive manner and enhanced the learning process. Instructors generally agreed that the unit was useful in

facilitating troubleshooting instruction and that it displayed operational systems in a realistic manner. The instructor group was not as favorably inclined toward simulator mobility and maintainability, however, they were generally not unfavorably inclined.

With regard to student attitude toward simulator instruction, several comments can be made. Although a descriptive comparison of attitudes was made, there is an obvious absence of major attitudinal differences between the group exposed to simulator instruction and other groups exposed to different instruction. It is difficult to generalize from this type of data, however, for the present, it appears that students' attitudes toward this type of individualized simulator instruction are not radically different from their attitudes toward other instruction in other environments.

Implications

Several implications can be identified which have relevance to program improvement in vocational and technical education. First, the results should provide meaningful information to vocational educators at the state level. Since the simulator has shown utility in providing troubleshooting instruction to the extent of transfer to actual equipment, state planners should give serious consideration to the use of this type simulator in areas where the development of complex skills is critical. Of course, cost is an important factor. However, a small computer or piece of machinery would be comparable in cost and might not have a general purpose capability. As the project was being completed, the various schools were quick to move the simulators into other instructional areas and provide troubleshooting instruction on different systems.

Second, in order to maximize simulator use, directors and teachers would do well to specify instructional objectives and state how a simulator might aid in attaining these objectives. Simulation could then be utilized in accordance with instructional priorities. Scheduling a simulator might be similar to scheduling an audio-visual aid. The result would be maximum utilization and a reduced cost per student.

A final implication focuses on student characteristics. It appears that, by providing self-paced simulator instruction, the effects of variables typically associated with low achievement (i.e., verbal ability) were minimized. Instructors should attempt to use simulation in an individualized self-paced manner as much as practicable. In this way, certain differences among students might be held to a minimum. This, of course, does not mean that all individual differences are minimized. The instructor should be aware of student characteristics which relate to the performance described (i.e., proficiency, efficiency) and match these characteristics with specified instructional outcomes.

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INVESTIGATION OF THE EFFECTIVENESS OF A DESIGN TO INITIATE CURRICULUM CHANGE

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AN INVESTIGATION OF THE EFFECTIVENESS OF A DESIGN TO INITIATE CURRICULUM CHANGE[1]

Mary Bach Kievit

This report describes action to promote curricular change and research to evaluate the impact of that action. The significance of this investigation becomes most apparent when viewed as 1) an endeavor to design one specific approach to dissemination of information to practitioners with the purpose of motivating each to become an agent of change in a specific area within the local school; and 2) through a quasi-experimental design to ascertain the extent to which the treatment was effective in promoting change.

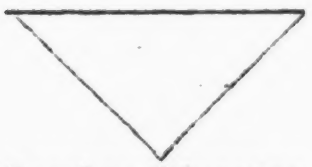
The design for initiating change is: selecting and training of teachers by teacher educators, to serve as leaders of workshops for other teachers; planning, selecting, and developing content, techniques, and evaluation procedures of workshop sessions; conducting workshop sessions for teachers within reasonable traveling distance. The content to be disseminated, or the skills to be developed would vary in relation to the curriculum change sought. Such a design is applicable to much curriculum and instruction. The design is presented schematically in Figure 1.

[1]The research reported herein was performed pursuant to grants from The Research Coordinating Unit for Vocational-Technical Education, Bureau of Occupational Research Development, Division of Vocational Education New Jersey State Department of Education under the Vocational Admendments, Part F. Ancillary Funds.

Figure 1. Design for Curriculum Change

Phase I

Leadership Development
(August, 1967)



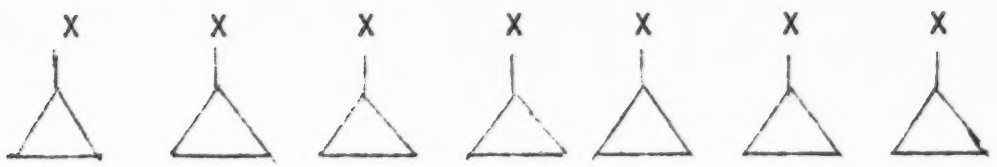
Teacher Educator

X X X X X X X

Seven Teachers

Phase II

(January - April, 1968)



Σ = 79 Teachers

= 6 to 20 Teachers participating in workshops

Stimulus for Change

The content disseminated in workshops pertained to incorporating wage-earning emphases in secondary school programs of home economics.

Teachers to serve as workshop leaders were selected on the following criteria; demonstrated understanding of and ability to communicate the need for occupational education and information relevant to necessary curriculum change; that as a group, leaders be from geographically dispersed

areas throughout the state. This latter criterion was included to facilitate reaching teachers in all parts of the state, with the leader serving in an area close to her residence, thus reducing some deterrents to participation.

Each potential leader was approached personally. In each case, the preferred person accepted the position to serve as a leader and to participate in leadership preparation with remuneration at an hourly rate of six dollars. When these teacher-leaders responded to a modified version of Rogers scale to measure self-perceptions as an opinion leader, near the conclusion of the workshops, their scores exceeded those of the experimental and control groups, indicative of more opinion leadership.[2]

Preparation for Leadership

Teachers to serve as leaders were prepared for this role through involvement in the selection and preparation of content material for in-service workshops, planning the methods of presentation, and consideration of the dynamics of group interaction as it facilitates or impedes group productivity.

The resources from which workshop materials were selected had been developed in two sucessive summers in a graduate course. In general, the content provided answers to these basic questions: Why should home economists contribute to preparation for employment in secondary school programs? What types of programs could be initiated and under what circumstances? How could the teacher proceed to implement curricular changes?

[2]Unfortunately leaders were not asked to respond to the six item scale prior to their being selected and prepared to lead workshops. In the absence of this information, it is impossible to say the extent to which high scores were influenced by being placed in a leadership position.

The need for spontaneous sharing of ideas and feelings, and the worth of the group product, was emphasized throughout the planning. From the second day on, the leaders worked as a well integrated group, structuring tasks, completing these and moving to the next. Group interaction of leaders was task-oriented, emphasizing a team approach, which led to considerable esprit de corps within a short period of time. Planning and subsequent evaluation sessions were characterized by constructive criticisms and disagreements within a context of shared objectives, support, and positive reinforcement. In this manner by the end of one week, the group had completed lesson plans for seven workshop sessions.

From this planning each leader's workshop kit developed. Materials developed for each session included:

1. session plan for leaders.
2. mimeographed papers on session topic to be distributed to participants.
3. visual.
4. evaluation form.

Sessions differed in relation to the specific aims of each. The commonalities which did exist emerged from the concern to provide a model for effective instruction. Thus, each session began with a review and summary of the preceding session since there was a lapse of two weeks between sessions. Each session was patterned for movement. For example, review and summary to focused discussion and widespread participation, to leader presentation, to group formulation of conclusions, to group focused discussion, to evaluation, to termination.

During a four month interval after this week of preparation, materials for use in the workshops were duplicated and visuals were prepared.

Leaders worked together two additional days immediately prior to the

beginning of the workshops. One morning was devoted to presenting information and discussing "Group Dynamics in Workshops." The remaining time allowed leaders to become familiar with the supportive materials from their earlier work.

Context for Leadership

The context for leadership was in-service workshops for other home economics teachers in comprehensive high schools. The original plan was to hold workshop sessions in the schools where leaders were teaching. In three cases, however, school facilities more favorably situated were obtained.

Each workshop was scheduled for seven two-hour sessions to be held on alternate weeks during the months of January through April. Some flexibility of time, late afternoon or evening, was left to the leader and group. Workshops at all locations did in fact meet immediately after school.

Selection of Teacher Participants

The names of home economics high school teachers within a 10, 25, and 40 mile radius of a workshop location were listed. The number of potential workshop participants varied for each workshop, the numbers being less in moderately or sparsely populated areas of the state than in the more densely populated northeastern counties. Four factors determined the teachers to be invited: 1) geographical proximity to the workshop location; 2) limit of 18 invitations per workshop; 3) when potential numbers of participants exceeded 18, a random sampling technique was used to determine who would be invited; and 4) did not have a home economics occupation course. One hundred and twenty-six invitations were extended. Eighty-eight accepted the invitation to attend and 87.5 percent attended six or more of the seven sessions consistituting each of the seven workshops.

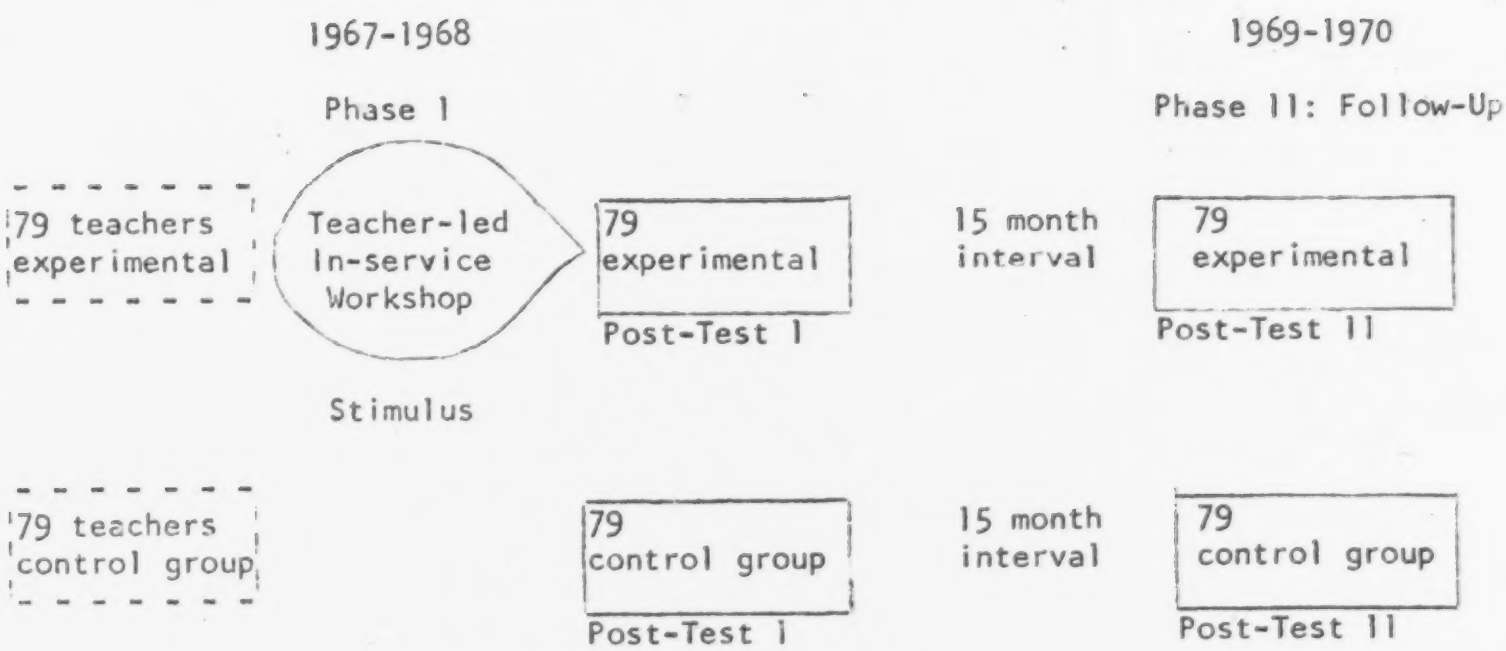
Motivating Teachers to Attend

Since each workshop session had been integrated with the others to move from the "Why" and the "How", it was considered essential by leaders and project staff that participants be reasonably regular in attendance. Attention was given to providing for both extrinsic and intrinsic motivational forces, limited though these were. Emphasis in letters was placed upon the fact that teacher participants had been selected to be invited; that participation was not open to all. It was thought that administrators informed about the invitation extended would provide support for attendance. Through the cooperation of the Division of Vocational Education, State Department of Education, certificates of completion of one credit of in-service education (i.e. non-degree) were given participants who were present for a minimum of six of the seven sessions. Last, a diligent effort was made to make each session informative, thought-provoking and of such value that participants would want to attend subsequent sessions.

Effectiveness of Leadership

Criteria for assessing the effectiveness of leadership included leaders' assessment, and participant evaluation of each session and of workshops as total experiences. Between 80 and 90 percent of participants rated each workshop session excellent or good. Over 90 percent thought the workshops should be continued for other teachers in the state. Perhaps the most forceful evidence of success is that 88 percent (77) of all teacher participants missed no more than one of seven sessions.

Research Design



Workshop participants constituted the experimental group in the research design. A control group was selected by a random sampling technique from a list of names of all secondary teachers of home economics in the state, after the names of workshop participants were excluded. No treatment was given to the control group which was used primarily to be able to answer these two questions:

1) in what characteristics and to what extent do teachers in the experimental group* differ from being representative of secondary home economics teachers in the state; thus limiting the extent to which findings can be generalized;

2) to what extent can changes in curriculum be attributed to the stimulus, i.e. in-service workshops, rather than to other factors such as reading about and implementing curriculum ideas from professional literature, contact with teachers who have modified courses in

*It was not known whether the criteria employed in selecting teachers for the experimental group had resulted in an atypical group of teachers. The use of a representative control group provided comparative data for determining this.

other schools, and administrative pressure, which were experienced in varying degrees by all teachers.

The control group would be affected by such factors while not experiencing the in-service workshops. Teachers in the experimental group would be subject to both types of influences.

In Phase I, data were obtained from 79 teachers in the control group by interview; this number constituted 82 percent of the sample drawn. Loss of cases and reasons are reported in detail elsewhere (Kievit, 1970). Comparable data were obtained from 79 workshop participants in sessions five and seven.

An area of secondary concern was whether significant differences existed on selected variables between teachers who attended the workshops and modified curriculum and those who attended but did not modify curriculum. In effect asking, "is this design of dissemination and motivation effective for teachers with identifiable characteristics but not for others?". The answer to this question, potentially provides more relevant information for designing alternative approaches to dissemination activities for specific populations where the known probability of success of the design described here is least.

A third question to which answers were sought was: Do teachers who alter curriculum, irrespective of stimulus, i.e. workshop or other influences differ significantly on selected variables from those who do not alter curriculum?

Phase I was used to test out the adequacy of measures on these selected variables: demographic characteristics, curriculum change, professional involvement, teaching effectiveness, work orientation, job satisfaction, self-perception as an opinion leader, belief system and risk-taking propensities. Most of the measures were found adequate as a basis upon which to differentiate among respondents. (Kievit, 1970).

In sum, during the first stage of the project, it was evident that the

stimulus for change, i.e. the workshops, had been successfully implemented. Data obtained from the workshop participants as the experimental group and from the control group were adequate to provide a base for comparison, over time, in terms of the extent of change to incorporate wage-earning emphases.

Further, the findings indicated that teachers in the experimental and control groups were very similar in: socioeconomic origins; being upwardly mobile; and patterns of employment, when age variations were considered. They differed in that the teachers in the experimental group tended to be older, be married, have more children, and fewer masters degrees than those in the control group. Slightly higher proportions of teachers in the experimental group reported more professional involvement than did those in the control group.

No significant variations were found in management of domestic responsibilities, self-evaluation of teaching effectiveness; open-closed belief systems (dogmatism); risk-taking propensities; and work orientation. Experimental group respondents on two measures of job satisfaction tended to report somewhat lower satisfaction than those in the control group. Somewhat unexpectedly, experimental group respondents did not as strongly perceive themselves as opinion-leaders as compared to control group respondents.

In sum, on most of the variables measured the experimental and control groups were very similar, thus supporting the assumption that the procedures utilized for selecting teachers to participate in in-service workshops did not create a sharply atypical experimental group.

Follow-Up: Phase II

The follow-up was initiated in June, 1969 approximately fourteen months after the workshops were completed. The objectives of the follow-up were to ascertain:

1. The number of teacher participants in teacher-led in-service workshops who after fifteen months had in fact initiated curriculum change by incorporating wage-earning emphases in home economics; the extent and nature of change.
2. The extent to which the number of teachers modifying curriculum exceeded the frequency with which such change could have been expected to occur without the benefit of teacher-led in-service workshops.
3. Whether participants who modify curriculum differed significantly on selected characteristics from those participants who did not modify curriculum.
4. Whether, irrespective of stimulus, teachers who adopted wage-earning emphases, thus altering curriculum, differed on selected characteristics, from those who did not adopt wage-earning emphases.

A conceptual framework was sought to strengthen the effort to include measures of as many relevant variables as feasible, so that maximum understanding of relationships between the dissemination activity, the characteristics of teacher participants, and action or inaction relative to curriculum, would result. Rogers (1970 1-26) points out the similarity between elements in the diffusion of innovations and the S-M-C-R-E communication model. This communication model provides a conceptual framework which is helpful in describing the different components of this study and appears as Figure 2.

(Modified S M C R E Communication Model)

Source	Message	Channel	Receiver	Effects
Teacher-Educator as Change Agent via Opinion Leaders	Knowledge about and persuasion to use innovation: i.e. wage-earning emphases in Home Economics programs in comprehensive high schools. Characteristics of innovation 1. relative advantage prestige value from a) other home economists b) superordinates c) clients, i.e. students community increased job satisfaction 2. compatibility R) attitudes towards e) vocational education c) attitudes towards e) employment of i) women v) e) r) 3. complexity complete adoption would rate high on complexity; becomes a contingent decision to adopt 4. trialability could be tried in stages with the first an optional decision 5. observability moderate observability of results student response to course improved attendance interest, increased enrollment	1. Professional activities, e.g. journals, interaction with peers and superordinates at the local, county, and state level, which included wage-earning emphases as one of many professional concerns. 2. Teacher (opinion-leaders) conducted in-service workshops for other teachers a) homophilous leaders b) interpersonal c) credible, i.e. either had adopted innovation or were in process d) were of slightly higher social status e) length of time - 14 clock hours	As members of a system Teachers of Home Economics in comprehensive high schools who had not adopted innovation. Characteristics related to adopter categories P) dogmatism e) risk-taking r) propensities s) time restraints o) professional- n) domestic a) familial- l) demographic P) teaching effec- r) tiveness o) job satisfac- f) tion e) professional s) involvement s) opinion leader- i) ship o) perception of n) supportiveness c) of the system l) to change	Consequences over time Movement through stages in adoption process 1) awareness 2) interest 3) evaluation 4) trial)curri- 5) adoption)culum)change

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Respondents and Data Collection

Of the 158 teachers contacted, complete or partial follow-up data were obtained by personal interview from 129, i.e. approximately 82 percent. The lost cases were almost evenly distributed between the experimental (14 cases) and the control (15 cases) groups. Reasons for loss of cases were: 1) left position without a forwarding address, 10; 2) moved out of state and failed to respond to mailed questionnaire, 5; 3) refused to schedule an interview,5; 4) deceased or severe prolonged illnesses, 3; 5) data returned incomplete, 3; 6) miscellaneous, 3.

Limitations

Valid generalizations pertaining to the effectiveness of the design for information dissemination to induce change are limited to the specific innovation chosen to be presented, namely incorporating wage-earning emphases in home economics. This study in effect constituted a first step in testing the design which could be followed by subsequent tests using different content and/or skills to be disseminated.

No specific effort was made to control for a Hawthorne effect. Several factors, however, would seem to reduce such effect. Specifically, there was very little attention on the "specialness" of the experimental group, except in the initial invitation to attend workshops. Some emphases may have resulted informally among teachers as they interacted with peers. However, the change in curriculum sought required time to plan, effort to implement and to continue over months of instruction. Further, at no time during the conduct of the workshops or the interviews with teachers in the control group were participants told that information about their efforts to change curriculum would be sought $1\frac{1}{2}$ years later.

Evidences of change are self-reported, i.e. teachers reporting whether

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curriculum has been altered. Within the limits of the project evidences of change from external sources were not feasible; e.g. periodic and systematic before and after observation by an outside observer. The presence of an outside observer would introduce another variable which could be additive to the workshops as a stimulus for change and thus raise the question whether workshops sans observers would produce the same effect.

Generalizations about relationships between changing curriculum and selected social-psychological variables are limited to change which incorporates this specific innovation. No case can be made on the basis of data from this project that teachers who adopt or reject wage-earning emphases would also generally be receptive or resistant to all other innovations in curriculum.

Findings

Extent of Curriculum Change

The first objective of the follow-up was to ascertain the number of teachers in the experimental group who reported having initiated curriculum change by incorporating wage-earning emphases in secondary school programs and to compare this with the number of teachers reporting similar change in the control group. Thus, those teachers who responded "yes" to the question, "Have the high school home economics courses which you teach been modified or extended to incorporate a wage-earning emphases?" and who were able to substantiate their claim by describing the change were categorized as having changed curriculum. All others were categorized as not having changed. Table 1 reports the number of teachers reporting curriculum change.

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TABLE 1 Respondents Teaching Wage-Earning Emphases as Reported in the Pilot Phase and Follow-Up by Experimental and Control Group

	Pilot Phase 1967-68			Follow-Up 1969-70			
	Total N	N	Percent	Total N	N	Percent	Percent Gain
Experimental	79	1	1.2	65	14	20.2	19.0
Control	79	22	27.8	64	19	29.6	1.8

As can be noted from Table 1 the number of teachers in the experimental group reporting wage-earning emphases increased by 13 from the pilot to the follow-up, reflecting a percentage gain of 19 points, as contrast to a decrease in numbers from 22 to 19 for the control group, though reflecting a gain of 1.8 percentage points. It should be recalled that one criterion for including teachers in the experimental group had been the fact that she was not teaching an occupations course. The control was selected to be representative of home economics teachers in the state, and thus included a proportion teaching wage-earning emphases in various ways. On this basis it can be stated that the gain of 1.8 percent increase constitutes an index of the rate of change for incorporating wage-earning emphases over a 15 to 18 month period as a result of a variety of influences, excluding, however, teacher-led in-service workshops. Further, data from the experimental group indicated that the workshops increased change by 17.2 percent over what could have been expected without the workshops, i.e. assuming a rate of change equivalent to that evident in the control group. Thus, in effect the workshops stimulated slightly less than 10 times the change to be expected without them.

Certain assumptions are essential to the validity of these deductions. First, that the experimental and control groups are comparable in those characteristics related to change; and secondly, that the cases lost from each

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are not atypical in reference to having incorporated wage-earning emphases. With reference to the first assumption, discriminate analysis for two groups which included 24 variables related to adoption had a mahalanobis D Square of 1.50 and failed to be significant. Thus indicating that on the basis of these variations it was not possible to discriminate between the experimental and control group.

With reference to the second assumption, it can be stated that of 15 teachers in the control group who did not participate in the follow-up, 7 had reported incorporating wage-earning emphases. Of the 7, 4 had left the schools in which they were teaching in 1967-68 and could not be located; 1 had moved out of state, and 2 refused to be interviewed. Inasmuch as the experimental group was chosen on the criteria of not having an occupations course, non-respondents in the follow-up from the experimental group without exception had not reported having adopted the innovation in 1967-68 during Phase 1. What happened during the period between the workshops and the follow-up for non-respondents in either group can only be speculated.

Table 2 reports differences between experimental and control groups including non-respondents, who are treated as if practices reported at the time of the pilot were continued.

TABLE 2 Revised Number of Respondents Teaching Wage-Earning Emphases, Assuming Non-Respondents in the Follow-Up Continued Practices Reported During Pilot by Experimental and Control Group

	Phase I 1967-68			Follow-Up 1969-70			
	Total N	N	Percent	Total N	N	Percent	Gain Percent
Experimental	79	1	1.2	79	14	17.7	16.5
Control	79	22	27.8	79	26	32.9	5.1

Employing the assumption of continuity in practices for non-respondents in the follow-up, the gain for the experimental group is reduced from 19 to

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16.5 percent; and increased from 1.8 to 5.1 percent for the control group. Thus, the gain attributable to the workshop is 11.4, i.e. assuming 5.1 percent of the gain for the experimental group resulted from the same influences experienced by the control group. Thus a conservative appraisal indicates that workshops contribute twice the frequency of change to be expected without workshops.

One additional approach was used to ascertain the frequency with which teachers in the experimental group reported changes as compared to those in the control group. In this approach, responses of teachers were analyzed who 1) had reported in 1967-68 that they had not modified their courses to incorporate wage-earning and 2) were teaching in 1969-70 and had provided data for the follow-up. Thus this analysis eliminated respondents in both the experimental and control groups who had left teaching and in effect could not have modified courses even if so inclined. Table 3 reports the results.

TABLE 3 Teachers Reporting Courses Changed to Incorcorate Wage-Earning Emphases by Experimental and Control Group

	Changed		Did not Change		
	N	Percent	N	Percent	Total
Experimental	14	23.3	46	76.7	60
Control	8	15.7	43	84.3	51

x^2 = .93 n. sign.

These results indicate that the proportion of teachers participating in workshops reporting change exceeded by 7.6 percent, the proportion in the control group reporting change.

Findings indicated that the workshops quite probably provided information necessary for teachers already aware of the innovation for some years to actually take an initial step in adopting it. It was evident that for 1/5 of the experimental group, workshops introduced the innovation. Further, the

data indicated almost a 3 to 5 year time lapse between initial contact with the innovation and some implementation. Thus, it is reasonable to conclude that for a number of the workshop participants reporting no change, the workshops may be serving as a component of the exploration stage, intermediate between initial contact and trial adoption.

Deterrents to Adoption

Conceptually, deterrents to adoption may be linked to inadequate relative advantage, through inconvenience, and limited if any economic or social rewards, attached to adoption. Similarly, deterrents may exist in other characteristics of the innovation, e.g. complexity in the system. Responses to several questions elicited information pertinent to understanding deterrents to incorporating wage-earning emphases.

First, since the stimulus to change was in effect a specific design for the dissemination of information relative to an innovation in curriculum, respondents were asked from what sources they had obtained the most up-to-date information about home economics curriculum. Since the question was purposely open-ended, the responses were analyzed in terms of the frequency with which different modes of information dissemination were mentioned.

Table 4 reports the results.

TABLE 4 Sources of Most Up-To-Date Information Cited by Experimental and Control Group Categories

	Experimental		Control	
N=	13	52	20	44
	Change Percent	No Change Percent	Change Percent	No Change Percent
Professional Meetings	30.8	21.2	25	24.4
Workshops	46.2	40.4	20	14.6
Professional Magazines	61.3	55.8	50	63.4
State Department	30.8	25.0	5	29.3
Other Teachers	15.4	13.5	20	19.5
College Courses	23.1	9.6	30	19.5

Professional magazines were considered by the largest proportions to provide the most up-to-date information about curriculum. For the experimental group, workshops ranked second to professional magazines. In view of the professional journals listed, and the proportions of teachers indicating they "usually" read these magazines, findings support the opinion that present information dissemination about wage-earning as an innovation is limited.

Secondly, when asked about problems encountered in changing curriculum, no single problem was cited by a sizeable proportion. Slightly over 20 percent of the experimental group having changed, reported problems of physical facilities, as did 15 percent of the control group. Fifteen and 23 percent of the experimental and control group respectively, reported the "calibre of students" a problem. Seven and 35 percent of the experimental and control group respectively reported no problems.

In addition to analyzing the problems reported by those having changed curriculum, responses of experimental and control group teachers who reported 1) no wage earning, 2) no plans in process to incorporate wage-earning, and 3) teaching at the secondary level were analyzed. Forty three and 34 respondents met the three criteria in the experimental and control groups respectively. Almost 40 percent (17) of the experimental group and 53 percent (18) of the control group, gave no reason for not incorporating wage-earning emphases or indicated that such a change had not been considered. (The larger number in each reported not having considered such a change.) Slightly over 20 percent (10) of the experimental and 11 percent (4) of the control group reported that there was no need for such emphases. Approximately 17 percent of each group indicated physical facilities were a deterrent. The remaining 15-20 percent of respondents cited a variety of reasons including: limited funds for personnel and facilities; lack of interest by administrator and students; not timely in terms of other school priorities; teacher perceiving self as having no authority to implement change; and lack of work stations in community.

In brief, a deterrent to adoption for the largest proportion was in the failure of each to seriously consider the potential value of the adoption in the local situation. This can be interpreted in several ways, first, that at the time of the follow-up these respondents were at the awareness stage and had not moved to the interest and evaluation stage. Secondly, for those teachers in the experimental group, workshop sessions had limited effectiveness in expediting the process of adoption. Apparently 20 percent of the experimental group and 11 percent of the control had reached the evaluation stage and decided wage earning emphases were not needed in programs in the local situation. For others, as well, relative advantage of innovation to the adopter and to the system, was a deterrent in addition to situational constraints and role perceptions of teachers.

Characteristics of Adopters and Non-Adopters

Consistent with the third and fourth objectives of the study, data on the variables specified were analyzed in terms of the experimental group, dichotomized on the basis of reporting change in curriculum and no change in curriculum, and compared with data for the control group dichotomized on the same basis. Subsequent to that analysis, teachers in the experimental and control groups were combined and then dichotomized on the basis of having changed curriculum and not having changed. Data were then analyzed to ascertain whether significant relationships existed between adopting the curriculum innovation and each variable. Inasmuch as a comparison of findings showed that results from these two approaches were the same except for two variables, findings are reported for the combined groups dichotomized as adopters and non-adopters.

Findings from this analysis indicated that teachers most likely to adopt the innovation of wage-earning emphases in home economics were teachers who:

1) are mature professionals, between 40 and 50 years old;

2) have stability in their teaching position;

3) report attitudes of family members are favorable to their employment;

4) value work as an end in itself;

5) perceive themselves as highly effective teachers;

6) report comparatively higher satisfaction with supervision and adult relationship on the job;

7) report participation in professional organizations;

8) see themselves as opinion leaders;

9) perceive the school system as being supportive of educational change;

10) perceive administrators, students, and community as viewing the innovation more positively;

11) have more highly positive attitudes toward vocational education

The first ten variables may show positive relationships with adopting other educational innovations as well as wage-earning emphases. Thus, the findings of this project support the consideration of these variables by investigators concerned with testing other designs for initiating educational change.

Two types of multivariate analysis were employed, multiple regression analysis and discriminate analysis for two groups. Multiple regression analysis found that eight variables account for 25 percent of the variance, with a multiple r of .50. These variables were 4, 5, 6*, 9 plus community's view of innovation, responsible vs. evasive classroom behavior, and warm vs. aloof classroom behavior. The discriminate analysis found that it was possible to discriminate between the two groups. The practical implications of this are somewhat exciting. Specifically, given limited resources with which to disseminate information relative to curriculum change. Information on selected variables would provide criteria on which to select the target population with the highest probability of being responsive, in action, to

*variables combined in this statement.

the message. In this particular situation, the cut-off Z value would be -0.12. All teachers below would be screened out, with the information disseminated to those with Z values at or above this level. Although slightly less than 1/3 of the non-adopters have Z values above this point, all of the adopters are within this range. The rationale is, then, that within this range those who will change are included, and that of all non-adopters, those with characteristics most closely resembling adopters have a higher possibility of becoming adopters.

Practically, it must be acknowledged that the cost in both time and money of obtaining and analyzing data on these selected variables might outweigh the gains. This might be true, particularly when contributions are made to movement through earlier stages of the adoption process. Such movement may be a desired outcome though it will not appear as reports of adoption. Perhaps the more immediate value of this particular analysis is linked to the potential it suggests.

In conclusion, findings support the feasibility of selecting participants most likely to be responsive to efforts to diffuse innovations. For those interested in furthering adoption of wage-earning emphases in home economics, some variables have been identified and found to contribute to discriminating between those most likely to adopt and not adopt. Future studies may help to identify which of these variables are generic to adoption of most educational innovations, and which are linked to the unique characteristics of a particular innovation. Specifically, the variables of self-evaluation of teaching effectiveness and teacher perceptions of the supportiveness of the school system to change hold promise of wider applicability. The designs of future studies in this area might benefit by including several categories of variables; one, variables potentially generic to adoption behavior in education and secondly, variables related to characteristics of the particular innovation

being studied, and related to adoption or non-adoption. Further, the findings suggest that variables of a more general level such as demographic characteristics, dogmatism, risk-taking propensities, and attitudes towards employment of women have less discriminating power than those related to the individual's performance as a professional, and the perception of situational facilitators and constraints. Thus research efforts might be more advantageously expended in identifying and investigating variables more specifically linked to the innovation, mode of dissemination, setting in which adoption must occur, and the functioning of the teacher within that setting.

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